

WHAT IS CLAIMED IS:

- Sub B1*
1. A method for forming a bump, comprising:  
forming an opening in an insulating film which exposes at least a part of a  
pad;  
5 forming a bump connected to the pad;  
forming a resist layer that defines a through hole which overlaps at least a  
portion of the pad; and  
forming a metal layer connected to the portion of the pad exposed at the  
opening.
  - 10 2. The method for forming a bump according to claim 1, the through hole  
being formed so as not to protrude from a periphery of the pad.
  3. The method for forming a bump according to claim 1, the insulating  
film being thicker at an end of the pad than at a center of the pad.
  - 15 4. The method for forming a bump according to claim 3, the through hole  
being formed at an inner side of a periphery of the pad and at an outer side of the  
center of the pad, in which the insulating film is thinner.
  5. The method for forming a bump according to claim 1, the metal layer  
including a first metal layer and a second metal layer formed on the first metal layer.
  - 20 6. The method for forming a bump according to claim 5, the opening  
being formed so as to be larger than a periphery of the through hole so as to define a  
region for forming the first metal layer and an exposed portion of the pad, the second  
metal layer being formed so as to cover the exposed portion of the pad.
  - 25 7. The method for forming a bump according to claim 5, the first metal  
layer being formed in the through hole, the resist layer being removed, and then the  
second metal layer being formed so as to cover the first metal layer.
  8. The method for forming a bump according to claim 5, the first metal  
layer being formed in the through hole, and then the second metal layer being formed  
on the first metal layer without removing the resist layer.
  - Sub A4*  
30 9. The method for forming a bump according to any one of claim 5, the  
first metal layer being formed so as to protrude from the through hole so that the first  
metal layer has a tip having a width which is larger than a width of the through hole.
  10. The method for forming a bump according to any one of claim 5, the  
second metal layer being formed so as to protrude from the through hole so that the

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second metal layer has a tip having a width which is larger than a width of the through hole.

11. The method for forming a bump according to claim 5, the first metal layer being formed by electroless plating.

5 12. The method for forming a bump according to claim 5, the second metal layer being formed by electroless plating.

13. The method for forming a bump according to claim 1, further comprising the step of providing a solder on the metal layer.

10 14. The method for forming a bump according to claim 13, the step of providing the solder includes providing a resin layer at a periphery of the metal layer other than on at least an upper face of the metal layer so that the solder is provided at a portion of the metal layer that is exposed from the resin layer.

15 15. The method for forming a bump according to claim 13, the metal layer being formed so as to be substantially flush with the resist layer, and the solder being provided at a portion of the metal layer exposed from the resist layer.

16. The method for forming a bump according to claim 8, the first metal layer being formed so as to be lower than the resist layer, and the second metal layer being provided by a printing process using the resist layer as a mask.

20 17. The method for forming a bump according to claim 8, further including the step of forming a conductive film on the insulating material so as to be electrically connected to the first metal layer at a periphery of the through hole, the first metal layer being formed so as to be lower than the resist layer, and the second metal layer being provided by electroplating using the conductive film as an electrode.

25 18. The method for forming a bump according to claim 5, the first metal layer including a nickel-containing material.

19. The method for forming a bump according to claim 5, the second metal layer including a gold-containing material.

20. The method for forming a bump according to claim 5, the second metal layer including a solder.

30 21. The method for forming a bump according to claim 13, the solder including Sn, or Sn and at least one metal selected from the group consisting of Ag, Cu, Bi, and Zn.

22. The method for forming a bump according to claim 12, the second metal layer including first and second Au layers, the first Au layer being formed on

the first metal layer by immersion plating, and the second Au layer being formed on the first Au layer by autocatalytic plating.

23. The method for forming a bump according to claim 12, the second metal layer including an Au layer and a Sn layer, the Au layer being formed on the first metal layer by immersion plating, and the Sn layer being formed on the Au layer by autocatalytic plating.

24. The method for forming a bump according to claim 23, the step of forming the Sn layer includes forming the Sn layer with an electroless tin plating solution that contains at least one of Cu and Ag so as to deposit Sn and at least one of Cu and Ag.

25. A method for manufacturing a semiconductor device, comprising the method for forming a bump according to claim 1, the metal layer being formed on the pad formed in a semiconductor chip.

26. The method for making a semiconductor device according to claim 25, further including the step of electrically connecting the bump to a lead, the second metal layer in the bump and the lead thereby forming an eutectic crystal.

27. A semiconductor device manufactured by a method for making a semiconductor device according to claim 25.

28. A semiconductor device, comprising:  
a semiconductor chip having a plurality of pads;  
an insulating film formed on the semiconductor chip so that the insulating film covers at least an end of each of the pads, and the pads have regions which are not covered with the insulating film; and

a bump formed on each pad, the bump including a first metal layer formed in the region of the pads not covered with the insulating film so as to be spaced from the insulating film, and a second metal layer formed so as to cover the first metal layer and contact the insulating layer.

29. A semiconductor device, comprising:  
a semiconductor chip having a plurality of pads;  
an insulating film formed on the semiconductor chip so that the insulating film covers at least an end of each of the pads, and the pads have regions which are not covered with the insulating film; and

a bump formed on each pad, the bump being formed to have an end that is disposed on the insulating film, the bump covering the region of the pads, the

thickness of a portion of the insulating film that is laterally spaced from the pads being larger than a portion that is below the bump.

30. A semiconductor device, comprising:

a semiconductor chip having a plurality of pads; and

5 a bump that includes a pillar shaped body connected to each of the pads and a tip connected to the body, the tip having a width which is larger than a width of the body, the bump having a space for holding a solder between the tip and the body.

31. A circuit board, comprising: the semiconductor device according to claim 27.

10 32. An electronic device, comprising: the semiconductor device according to claim 27.

Patent to be published